CLAIMS

What is claimed is:

1. A method for detecting the fluorescence of a fluorescent sample in a channel plate having a channel axis comprising:

exciting the fluorescent sample with an excitation beam of light, wherein the excitation beam of light enters the sample at an angle less than or equal to about 45° longitudinal axis of the channel axis; and

collecting the fluorescence of the sample with a collection optics system, wherein the collection optics system collects the fluorescence and refocuses the fluorescence onto a detector.

2. The method as defined in Claim 1, wherein the detector comprises a detector selected from the group consisting of charge coupled devices, CMOS detectors, photodiode, photodiode array, photomultiplier tubes, photomultiplier tube arrays.

3. The method as defined in Claim 1, wherein the collection optics system collimates the fluorescence and refocuses the fluorescence onto a detector.

4. The method as defined in Claim 1 wherein the excitation beam of light enters the sample at an angle less than or equal to about 20°.

5. The method as defined in Claim 1 wherein the collection optics further removes scattered light from the excitation beam using a long pass filter.

6. The method as defined in Claim 1, wherein the collection optics further removes scattered light from the excitation beam using a band pass filter.

7. The method as defined in Claim 5 further comprising directing the excitation beam of light substantially parallel to the channel plate into a reflective mirror, which directs the excitation beam of light into the sample at an angle less than or equal to about 45°.

8. The method as defined in Claim 7 further comprising directing the excitation beam of light from the reflective mirror through a prism to direct the reflected excitation beam of light into the sample.

9. An apparatus for fluorescence detection of a sample comprising:

a light source operable to generate an excitation beam of light;

a mirror operable to reflect said excitation beam of light into the sample at an angle less than or equal to about 45°; and

a collection optics operable to collect fluorescence from the sample and refocus the fluorescence.

10. The apparatus as defined in Claim 9 further comprising a charge coupled device which receives the refocused fluorescence from said collection optics.

11. The apparatus as defined in Claim 9 wherein said collection optics further includes a long pass filter operable to remove scattered light at a wavelength of said excitation beam of light.

12. The apparatus as defined in Claim 9 wherein said collection optics further includes a transmission defraction grading operable to separate light into differing wavelengths.

13. The apparatus as defined in Claim 9 further comprising a prism operable to focus said excitation beam of light into the sample.

14. The apparatus as defined in Claim 9 wherein said light source is a laser.

15. The apparatus as defined in Claim 9 further comprising a channel plate defining a channel which houses the sample.

16. A method for fluorescence detection of a sample comprising:

providing a channel through which the sample is able to flow, the channel having an axis;

directing an excitation beam of light into the sample at an angle with respect to the axis of the channel;

generating a fluorescence image of the sample and a fluorescence image associated with the background, the fluorescence image of the sample being generated in a direction displaced from that of the fluorescence image associated with the background;

collecting fluorescence of the sample with a collection optics system, wherein the collection optics system collimates the fluorescence and refocuses the fluorescence onto a charged coupled device.

17. The method as defined in Claim 16 wherein said excitation beam of light is directed at the sample at an angle less than or equal to about 45° with respect to the axis of the channel.

18. The method as defined in Claim 17 wherein the excitation beam of light is directed at the sample at an angle less than or equal to about 20° with respect to the axis of the channel.

19. The method as defined in Claim 16 further comprising providing a laser to generate the excitation beam of light.

20. The method as defined in Claim 19 further comprising directing the excitation beam of light from the laser to a reflective mirror which directs the excitation beam of light into the sample at an angle.

21. The method as defined in Claim 20 further comprising directing the excitation beam of light from the reflective mirror through a prism to direct the reflective excitation beam of light into the sample.

22. A method of fluorescence detection using a charge coupled device having a plurality of detector elements, said method comprising:

(a) providing a channel through which a sample can flow, the channel having a channel axis;

(b) directing an excitation beam of light at an angle with respect to the channel axis so that the fluorescence image of the sample is generated in a direction displaced from that of the fluorescence image associated with background;

(c) determining the signal-to-noise ratio of a first group of detector elements;

(d) determining the signal-to-noise ratio of a second group of detector elements, said second group of detector elements including at least one detector element in said first group of detector elements;

(e) comparing the signal-to-noise ratio of the first group of detector elements to the signal-to-noise ratio of said second group of detector elements; and

repeating steps (c)-(e) with groups of detector elements of increasing number of detector elements until the signal-to-noise ratio of said second group of detector elements declines with respect to the signal-to-noise ratio of said first group of detector elements.

23. The method of fluorescence detection set forth in Claim 22, further comprising the additional steps of:

exciting the fluorescent sample with an excitation beam of light, wherein the excitation beam of light enters the sample at an angle less than or equal to about 45° with respect to the channel axis; and

collecting the fluorescence of the sample with a collection optics system, wherein the collection optics system collimates the fluorescence and refocuses the fluorescence onto a charge coupled device.

24. The method of fluorescence detection set forth in Claim 23, wherein the excitation beam of light enters the sample at an angle less than or equal to about 20° with respect to the channel axis.

25. The method of fluorescence detection set forth in Claim 22, further comprising:

providing a light source operable to generate an excitation beam of light;

providing a mirror operable to reflect said excitation beam of light into the sample at an angle less than or equal to about 45° with respect to the channel axis; and

providing collection optics operable to collimate fluorescence from a sample and refocus the fluorescence onto the charge coupled device.

26. The method of fluorescence detection set forth in Claim 22, further comprising collecting fluorescence of the sample with a collection optics system, wherein the collection optics system collimates the fluorescence and refocuses the fluorescence onto a charged coupled device.

27. An apparatus configured to measure fluorescence of a sample comprising:

a source operable to illuminate the sample with an excitation beam, said excitation beam having a propagation axis with an incident angle of less then about 45 degrees with respect to a surface of the sample;

collection optics operable to collect fluorescence from the sample, said collection optics having an axis which is greater than about 45 degrees with respect to the propagation axis of said excitation beam.

28. The apparatus according to Claim 27, wherein said axis of said collection optics is oriented about 90 degrees with respect to the propagation axis of said excitation beam.